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Economic aspects of cut-over land use in western Montana

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ECONOMIC ASPECTS OF CUT-OVER LAND USE IN WESTERN MONTANA

by

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TABLE OF CONTENTS

Page

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

In western Montana there is considerable cut-over forest land being cleared of its second growth timber in order to produce farm and livestock products. Forest, range and farm land all are important to the economy of this area, but a question exists as to which one of these uses the land is best suited.

Generally the forests which have been cleared and are being cleared, are found on readily accessible, level areas along narrow river valleys that may represent some of the best sites for tree growth. The clearing of this land may have an undesirable effect on the continued operation of the wood processing plants found in many western Montana communities. Lumbermen are finding it necessary to go farther and farther away from the processing plants in order to obtain logs. Foresters, farmers and county officials have been increasingly interested in the comparative values of the different uses to which the cut-over lands are being put. A survey conducted by the Forest Service during the 1940s and referred to by Hurtt (20) gives an indication of the extent of the area involved. He indicates that of 820,000 acres classed as agricultural land in 12 western Montana counties over 184,000 acres is cleared land.

The cost of clearing this land detracts considerably from its desirability for farming and ranching. Yet the high yields of forage and grain which have been obtained in the past indicate that a choice between

land uses does exist. As to the economic soundness of this choice there is some doubt.

An adequate economic analysis of the production from various land uses is needed after satisfactory production data have been obtained. The comparative values of timber, forage, and grain production should be compared on two bases. They should be compared on the basis of cost and income to the landowner and they should be compared on the basis of their product value to society. The economic value of any land use has at least these two aspects of importance and significance in a study of competitive land use.

The purpose of this study is to gather specific data on the productivity of these lands for forest, grain and forage crops, and to attempt a comparison of each on the basis of their contribution in net income to the landowner and in gross income to the community.

LITERATURE REVIEW

Numerous studies have been conducted on the use of cut-over land for farm crops and pasture. However, most of them are either farm management studies which deal with the feasibility of improved farming on cut-over land or economic surveys for land classification purposes. Relatively few studies have dealt with the comparative value of forest and other uses on the basis of market prices and actual yields.

Agricultural investigations which have been conducted in widely separated regions of the United States indicate that the problem of how to farm cut-over land is quite general (7, 12, 25). In most cases the problem of obtaining the best use of these lands centers around settlers who undertake the task of clearing the land for what they hope will soon be a profitable farm. Much of this land was originally cut over by large companies who had interest in the timber only and had little regard for the future development of the land (7, 15).

After these companies had removed the timber they sold the land at low prices to settlers who were interested in establishing themselves as farmers. Because cut-over land is inexpensive it is often purchased by people who possess limited amounts of capital. These purchasers buy the land for farm and ranch purposes but soon find that the cost of clearing enough land to provide a satisfactory income is more than they had expected. Having exhausted their finances on the initial purchase of the land, they often have no other alternative but to abandon it and

let it revert to the county for taxes (7, 10, 16).

A number of measures designed to improve this situation have been suggested. Students of land use often conclude their studies with a list of recommendations toward implementing better use of the land (15, 16). Nearly all indicate that a knowledge of the productive capacity of the soil for each of the competing products is one of the first essentials toward arriving at a solution (15, 26).

Studies in the cut-over regions of the Southern Coastal Plains (7), the Lake States (15), and the Pacific Northwest (12) indicate that many of these forest soils are capable of producing high yields of forage. In a survey of the cut-over pine lands of the south, Farley and Greene (7) indicate that under proper management the heavier soils are capable of producing good yields of feed crops and of supporting high quality pastures. However, the sandy soils, which predominate in this region, require heavy fertilization in order to produce satisfactory yields. Another study (8) in this area indicates that the native grasses, mostly of the sedge family, are valuable for beef production if managed properly.

McDowell and Walker (15) state that the heavier soils of the cut-over lands in Michigan, Wisconsin, and Minnesota produce high yields of red clover and alfalfa.

Land economic surveys have been conducted in the states of New York, Wisconsin, Michigan, Minnesota and Virginia. Each of these studies is of an individual county and is designed to obtain information which can be used in land use planning. In New York, Hill and Blanche (11), and Woodin (34) based their studies on the degree of intensity of the present land use. They found that a relationship exists between intensity of

land use, and the adaptability of the land for agriculture. They determined intensity of land use by rating the farms according to the number and quality of improvements, the crop being raised, and the soil quality. The least intensive use indicated that the land may be better suited to forestry or recreation purposes than to agriculture. Patteson and Shelton (22) found that a similar relationship exists in the state of Virginia.

In western Montana there exists a complexity of soil conditions which vary in their ability to produce cultivated crops. McConnell (20) states that some of these with which he has worked, particularly of the Cabinet and Mission series, are of value for hay and crop production.

In a survey of western Sanders County, McKay (16) found that little grain is raised due to the danger of summer frosts, soil deficiencies, and lack of markets. From interviews with farmers and ranchers in the area he reports that newcomers to the area attempt to raise grain but soon discover that conditions are more suitable to livestock and hay production.

Whether the cut-over land in western Montana can produce enough livestock feed to offset the costs of producing beef and butterfat is a question. It is a question that should be studied before the land is cleared.

Interest in the cut-over land use problem in western Montana has resulted in this subject being selected as the topic for discussion at a meeting of the Northern Rocky Mountain Section of the Society of American Foresters held in Missoula, Montana in 1945. The recommended primary objectives which resulted from the meeting were to, secure the greatest

long-time economic use of the land, stabilize land use, and secure the maximum benefits of such use to the community. The criteria of greatest value in effecting these objectives were indicated as, the effectiveness of the use in stabilizing the soil, the limitations to crop adaptability, the highest net annual return over a period of years, the highest gross value of the crop, and the need for the land to stabilize industry and to support public services.

It was indicated that if cut-over lands can be cleared of reproduction, and converted to the production of high quality forage, the value of the marketable livestock products may exceed the return from timber production. This has yet to be determined (20).

Pearson (23) says that, a comparison of timber and forage values on forest land should consider, first, the need for timber and livestock products, both locally and nationally, second, the returns from each in revenue to the land-owner and the public, and third, the capacity of each to support profitable industry. He indicates that these values can be compared at two levels of processing; (1), direct products of the soil, standing timber and standing forage, and (2), industrial products, lumber on one hand and meat or wool on the other.

Daniel and Ensminger (6) in a study of grazing practices on the cut-over lands in western Washington conclude that the returns in dollars per acre are probably greater for grazing than for growing trees if an economical ranch unit can be established.

Collins (4) and Baker (1) in comparing timber and forage values on the MacDonald forest of Oregon, used average prices of stumpage and average grazing fees for their area. They found that grazing was the

higher type of economic use when they were compared at this level.

Studies of land use based solely on cost and income, while of value as a guide, to the landowner, fail to give a full appreciation of the competing product values to the community. That the value of processing a commodity will often outweigh the value placed on the commodity in its raw form is well known. It has been estimated that the value of lumber manufacture in western Montana produces payroll and industrial profit values equal to six times the value of the stumpage to the forest landowner (20). It would be reasonable to expect that the use of land for the production of forage and grain would also produce returns to the community much in excess of what they are to the landowner.

There are many values which are affected by different forms of land use which are extremely difficult to measure. Aesthetic values, of forest over range or farming are extremely difficult to price as are those of wildlife, recreation, and watershed.

Where consumption of products takes place largely outside the community, a better indication of the product value is the gross monetary return f.o.b. the point it leaves the community (9, 24). Pearson (24) in applying these returns to forest and range production in the ponderosa pine type of the southwest found that forest compared well with range.

METHODS AND PROCEDURE

The procedure followed was: first, to collect specific information which would indicate the relative productivity of the soil for the various uses; second, to convert the determined yields to standard units of measure which will permit a comparison of their monetary values and, third, to compare the values of the various products according to current prices and costs of production.

Comparison units were selected in each of two recognized timber types in western Montana. The term comparison unit as used herein consists of a farm or ranch holding having cut-over forest land in pasture, hay, or farm crops, adjacent to forest land in timber production.

Nine of these units were located in the larch-Douglas fir Larix occidentalis Nutt.-Pseudotsuga menziesii var. glauca (Beissn.) Franco type, and one in the ponderosa pine Pinus ponderosa Laws. type in western Sanders County, Montana. Three were in the ponderosa pine type along the west side of the Bitterroot Valley near Florence, Ravalli County, Montana. Figure 1 shows the location of these units in western Montana.

Comparison units were selected on the basis of their land capability class, topographic uniformity, and the proximity of their various uses. No unit was studied on which there was: (1), danger of serious erosion taking place due to the removal of permanent cover; (2), variation in topography from one use to another, and (3), great distances between the locations of the various products being compared. Timber stands, hay

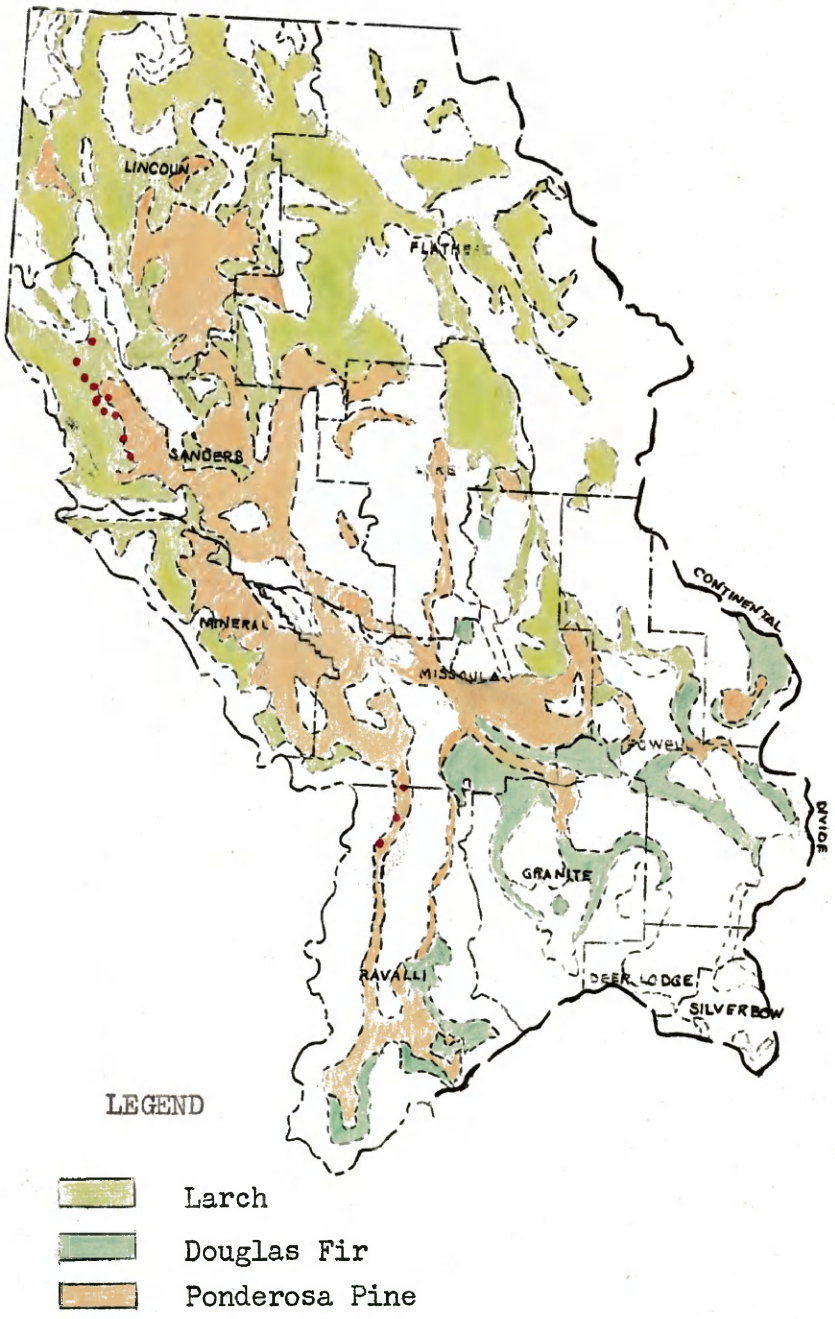

Figure 1.—Map of western Montana showing the location of the study areas relative to the range of larch, Douglas fir and ponderosa pine timber types. Red dots indicate approximate locations of comparison units.[1]

[1] Adapted from a United States Forest Service Map (32).

fields, pastures and grain fields were sampled for production during the summer and autumn of 1954. The forested portions of the comparison units were randomly sampled for the determination of present volume and growth. Data were later checked to ensure adequate sampling to within 10 percent of the true mean at the 95 percent probability level. Eleven plots on each comparison unit were adequate to ensure this degree of accuracy. On each plot the following data were recorded: (1) Number of trees by one inch diameter class, (2) Gross volume with deductions for defect applied on each plot, and (3) Height over age site index.

The first of these determinations (number of trees per acre by diameter class) is used to determine the basal area of the stand. This was necessary in order to determine what percent of the growing space available in the stand is actually being utilized for growth. Merchantable volume was determined in order that the stumpage value at the present time could be derived.

Site index measures the relative capacity of the site to produce wood. It is determined by measuring the heights and ages of several (usually 15 or 20) dominant and co-dominant trees in the stand. When the site indices of these trees are averaged they indicate the relative productive capacity of the site for the species involved.

To determine the relative stocking of each of the larch-Douglas fir stands the percent of crown closure for one stand was estimated and the basal areas of the others were related to the basal area of this stand.

Board foot volumes per acre were determined by applying the field data collected to appropriate volume tables developed by the Northern Rocky Mountain Forest and Range Experiment Station. A yield table

constructed by Cummings (5) was employed in determining rotation volume of larch-Douglas fir stands. To determine this value for ponderosa pine stands an inter-regional ponderosa pine yield table by Meyer (17) was used. The minimum diameter limits used were 13 inches for larch-Douglas fir and 12 inches for ponderosa pine.

Pasture yields were determined by two methods; one, clipping forage which was produced within woven wire exclosures; and two, clipping forage from unprotected areas which were left undisturbed throughout the growing season. A total of twenty-nine woven wire exclosures were installed on the pastures in the larch-Douglas fir type and sixteen were installed on the pastures in the ponderosa pine type. Exclosures were constructed of four posts driven to form the four corners of a square plot five feet by five feet in size. When wrapped with woven wire, twenty-five square feet of standing forage was protected to a height of three feet. Figure 2 shows one of these plots taken during the summer of 1954. The purpose of installing these exclosures was to ensure the existence of a representative sample of undisturbed forage at harvest time.

Clippings were taken during the months of July and August. Fields were checked at the close of the growing season for regrowth. A circular shaped ring made of heavy gauge wire was used to delineate 9.6 square feet of plot area to be clipped. Plots of this size are convenient to handle in the field, give a sensitive sample of the quantity of forage produced and permit convenient conversion to a pounds per acre basis. By simply multiplying the grams produced per plot by 10 the yield in pounds per acre is obtained.

All samples were weighed in the field. Every tenth sample was taken

Figure 2. One of the 45 Exclosures Installed to Determine Forage Production.

to the laboratory, air dried and re-weighed for the determination of moisture content. All sample weights were then converted to an air dry weight and expressed in pounds per acre.

Hay yields were determined in the same manner as pasture yields. Hay fields were sampled prior to harvest by clipping current years growth at mower height. Exclosures were not used for determining hay yields. Hay fields were protected from grazing until late summer by the ranchers. In only one case was livestock turned into a hayfield before the end of the growing season and those were so few in number that there was no difficulty in obtaining undisturbed samples of regrowth.

Grain yields were determined by interview with the farmers at the time of harvest. The total yield of grain in bushels was divided by the acreage in each particular grain field. Field acreages were determined by measuring the fields using compass and pacing for control.

A feed equivalent based on total digestible nutrients was used as an index of the value of pasture, hay, and grain for feeding purposes. Morrison (19) defines the total digestible nutrients as the "sum of all the digestible organic nutrients - protein, fiber, nitrogen free extract and fat."

The sources of cost and income used in the study were many. Where published information was not available or was not applicable, estimates made by producers, private businessmen, and public agencies were used. In all cases an effort was made to obtain and use reliable cost information.

The economic evaluation of different uses was made on an acre basis as were yield determinations. It is well known that many costs will vary

considerably according to the size of the unit. This variation was overcome in part by limiting the study to small ownership units and applying average costs and incomes as they exist, to all yields.

The comparison of returns from each type of land use was made at the following levels:

1. Values on the stem. By determining the cost of establishment and maintenance of hay, pasture, and forest plus the present price of the land and deducting this cost from the value of the standing forage on the one hand and from the stumpage value of the timber on the other.

2. Value of the harvested product delivered. By determining, in addition to the items mentioned in 1 above, the cost of harvesting and delivering the products. The products at the stage of processing in which they usually leave the farm. These are sawlogs on the one hand and butterfat or beef animals on the other. The yield value of forage and food grains was converted to butterfat and beef values by use of the recommended Morrison's standards on feed required for butterfat and beef production. The calculated butterfat and beef yields multiplied by the market price per pound at the point of delivery provides the second level of value of the crops to be compared.

3. Value of the product to the community. By using the f.o.b. price of the product as it leaves the community, a measure of the product value to the community is obtained. In western Montana these values would be the price of beef animals, butterfat, and finished lumber for the most part.

EXPERIMENTAL RESULTS

Production Characteristics of the Land

The timber stands on the units studied were found to be on good sites. Of the nine stands sampled in the larch-Douglas fir type, four are in site class I, and five are in site class II (5). Of the four ponderosa pine stands sampled one is in site class II, one is in site class III and two are in site class IV (17).

All are well stocked, even-aged, second growth stands of good vigor. The larch-Douglas fir stands have a higher proportion of larch than any other species. Some Douglas fir and scattered individuals of lodgepole pine Pinus contorta Dougl., ponderosa pine and Engelman spruce Picea Engelmanii Parry, are present. The understory consists mostly of Douglas fir, and western red cedar Thuja plicata Donn. The ponderosa pine stands in the Bitterroot Valley are pure stands.

On the units studied the predominant use of the cut-over land is for the production of dairy and beef products. Feed in the form of hay, pasture, and barley are the principal crops raised. Species used in re-seeding hayfields and pastures include red clover Trifolium pratense L., alsike clover Trifolium hybridum L., orchard grass Dachtylis glomerata L., alfalfa Medicago sativa L., and brome grass Bromus inermis Leyss. In most cases improved hayfields are seeded to a single legume such as red clover, alfalfa or alsike clover. All of the improved hayfields and pastures had been fertilized. The improved pastures are seeded with

mixtures including a legume and a grass. Red clover and orchard grass were the species used in one of the two pastures sampled, and an alsike clover, timothy mixture was used in the other. Most of the fertilizers used are those high in nitrogen and phosphorus. Some of the common fertilizers used are 10-20-0, 16-20-0, and barnyard manure.

The species represented on unimproved land include quack grass Agropyron repens (L.) Beauv., timothy Phleum pratense L., Kentucky blue-grass Poa pratensis L., red top Agrostis alba L., and white clover Trifolium repens L. The unimproved pastures possess a slightly higher percentage of blue grass and red top than the unimproved hayfields. Unimproved hayfields have a higher proportion of timothy and quack grass than unimproved pastures.

Grain produced on the units studied is mostly for livestock feed, but limited amounts are sold as a cash crop. Barley is the principal grain crop raised. Figure 3 shows a panoramic view of some field crops for which larch-Douglas fir forest soils are being used. In the background is grain crop land and hay land, in the left and right center are unimproved stump pastures. The field in the foreground is an improved hayfield which has been reseeded to red clover.

Forest Yields. -Predicting the growth of a given stand of timber with the use of yield tables requires the determination of three stand characteristics: (1) the age of the stand, (2) the site quality, and (3) the percent of the total area being utilized by the existing stand. Table 1 presents this information for each of the 13 stands studied. The last column shows the present volume of these stands as taken from local volume tables of the United States Forest Service. Values in this

Figure 3. Stump Pasture, Hay and Grain Fields Carved Out of Larch-Douglas Fir Forest.

table show volumes for each individual stand and the averages for each site class within each of the two forest types studied.

The average age of the site class I larch-Douglas fir is 46 years, it is approximately 60 percent stocked with an average volume of 900 board feet per acre. Those stands of larch-Douglas fir on site class II average 52 years old, are more fully stocked and possess a slightly larger board foot volume than those in site class I. All of the volumes for larch-Douglas fir are for trees 13 inches diameter breast high and larger.

Two stands, those of comparison units three and five are well below the average in merchantable volume. Both of these stands possess thick understories of a more tolerant species, western red cedar. According to Walker (33) understories of this nature sometimes occur on the better larch-Douglas fir sites and inhibit diameter growth of larch.

The ponderosa pine stands all occur within the three site classes II, III, and IV. The present volumes of these stands are higher than those of larch-Douglas fir. This is due in part to a lower diameter limit used on ponderosa pine than larch-Douglas fir. The fact that ponderosa pine is valued higher than larch-Douglas fir permits a more complete utilization of ponderosa pine. The minimum diameter limit used in determining ponderosa pine volumes is a 12 inch diameter class.

Appendix tables 1 through 4 show the volumes in board feet of larch-Douglas fir and ponderosa pine stands respectively at the ages of 70, 80, 90, 100 and 110 years. These values are for the indicated stocking percentages found on the 13 comparison units. Volumes for larch-Douglas fir are taken from a yield table by Cummings (5), and those for ponderosa

pine are taken from a table by Meyers (17).

Hay Yields. Tables 2 and 3 present the hay yields in pounds per acre of air dry forage and total digestible nutrients in pounds per acre. Values are shown by individual comparison units and are grouped by timber type and site class of the adjacent stands. Table 2 shows these values for improved hayfields and table 3 shows the values for unimproved hayfields. In the "species grown" column are the names of the major species which make up the stand. The percent digestible nutrients are taken from Morrison's Feeds and Feeding (19).

Improved hayfields exist on eleven of the units and unimproved hayfields on only three. Two of the unimproved hayfields are on fields adjacent to larch-Douglas fir timber stands which are in site class II. The third is in the ponderosa pine type adjacent to a stand in site class IV.

The fields which had not been reseeded developed from volunteer seeding of various species. Protection until the hay has been removed is about the only management they receive.

Pasture Yields. Tables 4 and 5 show yields per acre of improved and unimproved pastures respectively. Improved pastures were found on two of the comparison units. Both are adjacent to larch-Douglas fir timber stands which are in site class I. The yields from these pastures are very similar. Yields from unimproved pastures shown in table 5 range from a minimum of 906 to a maximum of 2,738 pounds of air dry forage per acre. The percent of digestible nutrients obtained in pastures is higher than that of hay. This is due to the fact that pastures are actively growing at the time they are consumed. Morrison (19) indicates that as plants

Table 2.—Yields of eleven western Montana improved hay fields in pounds of air dry forage and total digestible nutrients per acre.

Comparison Unit	Timber Type and Site Class		Species Grown	Forage Yield	TDN[1]	TDN
				pounds	percent	pounds
1	L-DF[2]	I	Alfalfa, Red Clover	5,400	49.8	2,689
2	L-DF	I	Red Clover	4,199	52.2	2,192
3	L-DF	I	Red Clover	6,507	52.2	3,397
4	L-DF	I	Alfalfa	3,298	50.3	1,659
Average				4,851		2,484
5	L-DF	II	Red Clover	8,996	52.2	4,696
6	L-DF	II	Alfalfa	2,501	50.3	1,258
7	L-DF	II	Alsike Clover	3,489	52.2	1,821
8	L-DF	II	Alfalfa	2,570	50.3	1,293
9	L-DF	II	Alfalfa	6,078	50.3	3,097
Average				4,726		2,429
10	PP	II	Red Clover	11,000	52.2	5,742
11	PP	III	Sweet Clover	7,209	42.4	3,057

[1] TDN refers to total digestible nutrients.
[2] L-DF and PP refer to larch-Douglas fir and ponderosa pine respectively.

Table 3.—Yields of three western Montana unimproved hayfields in pounds of air dry forage and total digestible nutrients per acre.

Comparison Unit	Timber Type and Site Class		Species Grown	Forage Yield	TDN[1]	TDN
				pounds	percent	pounds
7	L-DF[2]	II	Timothy, Quack grass	2,023	36.6	740
8	L-DF	II	Timothy, Quack grass	1,328	36.6	486
Average				1,675		613
13	PP	IV	Timothy, Blue grass	3,302	49.8	1,644

[1] TDN refers to total digestible nutrients.
[2] L-DF and PP refer to larch-Douglas fir and ponderosa pine respectively.

Table 4.—Yield of two western Montana improved pastures in pounds of air dry forage and total digestible nutrients per acre.

Comparison Unit	Timber Type and Site Class		Species Grown	Forage Yield	TDN[1]	TDN
				pounds	percent	pounds
3	L-DF[2]	I	Orchard grass, Red Clover	3,893	67.6	2,631
4	L-DF	I	Timothy, Alsike Clover	3,839	67.6	2,595

[1] TDN refers to total digestible nutrients.
[2] L-DF and PP refer to larch-Douglas fir and ponderosa pine respectively.

Table 5.—Yield of eleven western Montana unimproved pastures in pounds of air dry forage and total digestible nutrients per acre.

Comparison Unit	Timber Type and Site Class		Species Grown	Forage Yield	TDN[1]	TDN
				pounds	percent	pounds
2	L-DF[2]	I	Timothy, White Clover, Blue grass	1,824	67.6	1,233
3	L-DF	I	Timothy, White Clover, Blue grass	2,738	67.6	1,851
4	L-DF	I	Blue grass, Red top, Timothy	1,612	67.6	1,090
Average				2,087		1,391
5	L-DF	II	Blue grass, Red top, Quackgrass	1,189	67.6	804
6	L-DF	II	Blue grass, Red top, White Clover	1,905	67.6	1,288
7	L-DF	II	Blue grass, Red top, Timothy	1,614	67.6	1,091
8	L-DF	II	Blue grass, Red top, Timothy	2,398	67.6	1,621
9	L-DF	II	Blue grass	1,103	67.6	745
Average				1,642		1,106
10	PP	II	Blue grass, Red top, Timothy	1,528	67.6	1,033
11	PP	III	June grass, Needle and Thread	906	67.6	612
13	PP	IV	Red top, Blue grass, Timothy	1,659	67.6	1,121

[1] TDN refers to total digestible nutrients.
[2] L-DF and PP refer to larch-Douglas fir and ponderosa pine respectively.

Figure 4. Grain and hay on cut-over land.

mature their digestibility decreases. He explains this as being due to an increased proportion of undigestible lignin in the plants as they become more mature and weathered.

Grain Yields. Grain fields on these units are small. The larger portion of the cleared land on each unit was used for the production of forage crops. It is not uncommon to find fields of less than three or four acres producing all the grain that is produced on the farm. On the units studied in western Sanders County the grain crops are considered second in importance to forage crops. When harvesting grain conflicts with harvesting hay or with the care and management of livestock the grain harvest is usually postponed. This attitude along with rains which occurred during the proper harvest season in 1954 resulted in the grain harvest being delayed until late in the season. In one case snow fell before the farmer got around to harvesting his wheat and the wheat went unharvested. As a result of these practices grain yields may have been lower than could normally have been expected; however, what are considered good yields were obtained. Table 6 shows the grain yields as they existed on the units studied. Since grain is produced largely for livestock feed these values have also been converted to total digestible nutrients in pounds. Table 7 summarizes the yield data given in tables 1 through 6 for the various crops. Two site classes in the larch-Douglas fir type and three in the ponderosa pine type are indicated. Because the board foot values of larch and Douglas fir are somewhat less than the board foot value of ponderosa pine and because the different site qualities indicate different capacities to produce wood the yields of alternative crops have been classified according to corresponding timber types and

site classes. In all cases the average yield figures for alternative crops, adjacent to timber stands of a certain type and site class, are used. In some cases this is the average of several fields which were sampled adjacent to different stands, but of the same type and site class, and in a few it is the yield of a single field adjacent to the only stand of a particular type and site quality.

Table 6. Yield of barley, oats, and wheat in bushels and in pounds of total digestible nutrients per acre, from fields on cut-over land in western Montana.

Comparison Unit	Timber Type and Site Class	Yield per Acre					
		Barley		Oats		Wheat	
		Grain	TDN	Grain	TDN	Grain	TDN
		bu.	lbs.	bu.	lbs.	bu.	lbs.
1	Larch-fir I	35	1305				
2	" " "	30	1118				
3	" " "	37	1379				
4	" " "					12	576
Average		34	1267			12	576
5	Larch-fir II			56	1256		
6	" " "						
7	" " "	37	1379				
8	" " "	45	1678	45	1009		
9	" " "	50	1864				
Average		44	1640	50	1121		
10	Pond.Pine II	50	1864	45	1009	27	1290
11	" " III	44	1640				
12	" " IV			45	1009	40	1920
13	" " "						
Average				45	1009	40	1920

Table 7.—Average annual yield per acre of timber stands compared to average 1954 yields of hayland, pasture, and grain.

Timber Type	Site Class	Forest	Improved Hay	Unimproved Hay	Improved Pasture	Unimproved Pasture	Barley	Oats	Wheat
		bd.ft.	pounds	pounds	pounds	pounds	bushel	bushel	bushel
L-DF[1]	I	263	4,851		3,866	2,058	34		12
L-DF	II	174	4,727	3,029		1,642	44	50	
PP	II	237	11,000			1,528	50	45	27
PP	III	128	7,209	3,302		902	44		
PP	IV	85				1,659		45	40

[1]L-DF and PP refer to larch-Douglas fir and ponderosa pine respectively.

ECONOMIC ANALYSIS OF TIMBER PRODUCTION ON CUT-OVER LAND

Costs of Producing Timber Stumpage and Sawlogs.

In the past the second growth stands on the cut-over lands of western Montana in small private ownership have been considered mainly as a detriment to increased livestock and agricultural production. In most cases they have received no culture or management other than protection from fire. The major costs of holding these stands in their present condition are those of interest on the investment in land, protection from fire, and taxes. In order to establish the possible best uses of this land the net income values and the costs of production must be equated to the prices received for the various products the soil can produce.

Costs of maintaining the stands. In attempting a comparison of incomes from different types of land use, especially those involving long periods of time before a crop is harvested, it is necessary to consider a return on the money invested in the enterprise. This return should be at least large enough to compare favorably with the return obtainable had the money been invested in a risk free investment. Clark (3) states, "United States Government Bonds are as nearly a riskless investment as can be obtained." Since the rates on these bonds seldom exceed three percent, this is the rate selected for use in the following calculations.

Fire protection charges vary with location and fuel conditions. For purposes of this problem a charge of $.05 per acre per year is used.

This is the price charged by the Blackfoot Fire Protective Association and is considered a fair figure. At the present time there is no special forest tax in the state of Montana (21). According to the Sanders County Assessor, second growth stands are taxed the same as unimproved pasture lands.

The mill levy on the taxable value varies according to the school district in which the land is located. The units studied were located within two school districts each with a different mill levy. The one nearest the town of Thompson Falls, in the White Pine area, has a levy of 100.214 mills or slightly over $.10 per dollar of taxable value. The school district located in the vicinity of Trout Creek, Montana has a levy of 117.61 mills or $.1176 per dollar of taxable value. Applying these levies to the assessed values of the land, the taxes per acre would amount to approximately $.08 per acre per year for unimproved pasture and second growth timber land and $.33 per acre per year on the improved tillable land in the White Pine area. In the vicinity of Trout Creek the taxes amount to $.1058 per acre on the unimproved pastures and second growth timber land and $.39 on the improved tillable land. These are rates which apply to 1955.

The average tax per acre in 1954 for grazing land in Sanders County was $.09 and in Ravalli County it was $.13. The average tax for tillable non-irrigated land was $.38 per acre in Sanders County and $.27 per acre in Ravalli County (18).

Costs of Logging Timber. Estimates of logging costs were obtained from the local office of "Tree Farmers Incorporated." Logging costs will

vary according to the size of the timber being logged, the size of the logging operation, the accessibility of the stand and the differences in terrain. The estimated costs are $2.50 to $3.00 per thousand board feet for felling, limbing and bucking, $6.00 to $8.00 per thousand board feet for skidding, $1.00 per thousand board feet for loading, $.75 per thousand board feet for slash disposal and $.25 per thousand board feet per mile for hauling. These estimated costs are in line with the estimated costs used by the Polson Plywood Company of Polson, Montana in arriving at stumpage values. On certain inaccessible areas logging costs may be higher due to longer and more difficult hauls, or other special problems. The stands included in this study are located close to good roads which do not present any special logging problems.

Prices received for stumpage and sawlogs. Estimates of stumpage prices and log prices were also obtained from the local office of "Tree Farmers Incorporated." In some instances these estimates vary widely. However, it is believed that they set limits within which a fair value can be derived. They are as follows:

For Larch-Douglas Fir.

Prices per thousand board feet

Stumpage	$6.00 - $10.00
Log prices at the mill	$22.00 - $32.00

For Ponderosa Pine

Prices per thousand board feet

Stumpage	$10.00 - $30.00
Log prices at the mill	$35.00 - $50.00

From interviews with various loggers who are buying and with farmers who are selling stumpage on private lands, the prices being

paid are $10.00 per thousand for larch-Douglas fir and $15.00 per thousand for ponderosa pine. Since these are prices actually being paid to private owners for stumpage, they will be used in this analysis. As for other cost and income data averages of the values in the preceding paragraph will be used. The average price of uncleared cut-over land was estimated at $10.00 per acre and that of cleared land at $100.00 per acre by several producers who have recently either bought or sold such land or who have knowledge of recent sales.

The rotation applied to the growth of timber stands will affect the net income obtained from forest production. Bruns (2) defines the rotation as "the period of years required to establish and grow timber crops to a specified condition of maturity." He also states that the "rotation length is set on the basis of a site of average productivity on the particular forest." The financial rotation or that period of years through which the greatest average financial return per year is obtained has been calculated for larch-Douglas fir stands in site class I and II and for ponderosa pine stands in site classes II, III, and IV. The results of these calculated rotations are shown in the appendix tables 1 through 5.

The financial rotations as shown in these tables are considered somewhat shorter than average for this area. Interviews with Professor F. G. Clark of the Montana State University Forestry School and K. N. Boe, Research Forester for the Intermountain Forest and Range Experiment Station, United States Forest Service, indicate that a rotation of 100 to 110 years is considered a desirable rotation age for larch-Douglas fir. If allowance is made for natural regeneration the financial rotations will approximate 100 years. This age has been

selected for the following calculations. A rotation of 70 years is used in the ponderosa pine calculations. This is the most economical rotation found for ponderosa pine site class III and is average for the ponderosa pine stands sampled.

Income Possibilities from Timber Stumpage and Sawlogs.

If the farmers on these lands should decide to take advantage of the second growth timber which is already established on their land, and hold it until the calculated rotation age they can expect a higher average increase in value per acre per year than if they were to start with bare soil and carry the stand through a full rotation.

Possible income from existing stands. Table 8 attempts to show the possible returns available to the owners of the existing second growth timber stands if they hold them until they attain the calculated rotation age. This approach was recommended by Gevorkiantz (9) in an attempt to show the possible returns available to farmers in the mixed-oak type of Wisconsin.

The computations include cost and return data for each of five different stand types or site qualities. The table shows the present worth of the anticipated future net income should the stands be sold as stumpage or sold as sawlogs delivered to the mill. A detailed example of the method of deriving these values are shown in the appendix.

Possible income over the complete rotation. Tables 9 and 10 show the mean annual yield, mean annual net income, capitalized value, and the present value of the soil for producing timber crops. These are for the calculated rotations of the timber types and site classes on the comparison units studied. Again the forest stands are grouped according

Table 8.—Present worths of the possible future net returns per acre from holding the existing timber stands to their calculated rotation ages.

Comparison Unit	Gross Gain in Stumpage Value[1]	Annual Expenses[2]	Net Gain in Stumpage Value	Interest on Investment[3]	Present Worth of Future Net Income[4]	Value of Sawlogs	Total Costs[5]	Present Worth of Future Net Income[6]
	dollars	dollars	dollars	dollars	dollars	dollars	dollars	dollars
1-4	254.18	18.29	235.89	49.20	37.94	710.56	497.87	33.03
5-9	164.23	14.61	149.62	41.30	26.22	470.42	345.64	20.21
10	157.51	3.03	154.48	16.50	83.62	705.71	318.52	131.84
11	48.14	3.06	45.08	15.11	86.01	381.22	173.49	127.84
12-13	16.40	3.90	12.50	16.50	-2.42	227.58	105.64	63.84

[1]Gain in value of present existing stands carried to the calculated rotation ages.
[2]The accumulated annual expenses at rotation age compounded at the rate of 3 percent.
[3]Interest on the investment compounded at the rate of 3 percent.
[4]Present worth of future net returns from sale of stumpage.
[5]Total costs include annual expenses and logging costs.
[6]Present worth of future net returns from sale of sawlogs delivered to the mill.

Table 9.—The yield, total annual expenses, mean annual yield, capitalized value, and present value of the soil for producing timber stumpage.

Comparison Unit	Yield	Yield	Total Annual Expenses	Net Yield	Mean Annual Yield	Capitalized Value	Present Value of Fe at 3%[1]
	bd.ft.	dollars	dollars	dollars	dollars	dollars	dollars
1-4	26,317	263.17	14.00	249.17	2.49	83.00	4.31
5-9	17,423	174.23	14.00	160.23	1.60	53.33	2.77
10	16,605	249.07	12.60	236.47	3.37	112.33	14.20
11	8,970	134.55	12.60	121.95	1.74	58.00	7.33
12	3,280	49.33	12.60	36.70	.52	17.33	2.19

[1] Present value of Fe is the discounted future net income from the complete rotation.

Table 10.—The yield, total annual expenses, mean annual yield, capitalized value, and present value of the soil for producing sawlogs.

Comparison Unit	Yield	Yield	Total Annual Expenses	Logging Costs	Net Yield	Mean Annual Yield	Capitalized Value	Present Value of Fe at 3%[1]
	bd.ft.	dollars	dollars	dollars	dollars	dollars	dollars	dollars
1-4	26,317	710.55	14.00	500.02	196.53	1.96	65.33	3.40
5-9	17,423	470.42	14.00	331.03	125.39	1.25	41.66	2.16
10	16,605	705.71	12.60	315.49	390.22	5.60	186.66	23.59
11	8,970	381.22	12.60	170.43	198.19	2.83	94.33	11.52
12-13	3,289	139.78	12.60	62.49	64.69	.82	30.66	3.87

[1] Present value of Fe is the discounted future net income from the complete rotation.

to type and site class. Table 9 shows the values under the presumption that the timber is to be sold as stumpage, and table 10 presents values under the presumption that the timber crop is to be harvested and sold as sawlogs delivered to the mill. The costs of logging include the cost of hauling an estimated 15 miles. This is the approximate distance to the nearest mill from the stands on the units studied.

The values shown in tables 9 and 10 are the possible returns from stands under sustained yield management. Unlike the computations set forth for the existing stands, the annual costs and interest on the money invested in land are not compounded to the end of the rotation. Under sustained yield a part of the stand is harvested each year and returns are realized with each cut from which annual expenses can be paid. Consequently, it is not necessary to compound them to the end of the rotation.

ECONOMIC ANALYSIS OF HAY, PASTURE AND GRAIN PRODUCTION

Costs of Producing Hay, Pasture and Grain

Cost of clearing land. The cost of clearing land varies according to the character of the timber stands being cleared and the techniques applied in clearing. The Montana State Extension Service in their list of rates for custom work in Montana indicates a price of $20.00 and up per acre for clearing trees and stumps (28). This price is intended only as a guide and is general to all conditions in Montana. Clearing operations include cutting the trees, blasting the stumps, piling and burning the downed material. Usually the only work that is contracted out is the tractor hire used in piling the downed material. On two units where land was cleared recently the cost of hiring a crawler type tractor with dozer attachment amounted to an average of $56.00 per acre. In addition to this cost is the cost of cutting, blasting and cleaning. Eleven acres cleared on one unit required 84 man days cutting, 15 man days blasting, and 4 man days cleaning. Eleven hundred pounds of stumping powder was used. At the present time approximately 1000 board feet of timber can be salvaged from the clearing operation. If this is valued at the current price of stumpage, a deduction of $10.00 per acre can be made from the actual money outlay. Since cleared land can be bought for $100.00 an acre in this area an estimate of the return to the farmer for labor and blasting material can be derived by subtracting the cost of the uncleared land and the bulldozer work from the value of the

cleared land and adding to this the price of the salvaged timber. The sale value of cleared land or $100.00 minus the sale value of uncleared land $10.00, and the cost of bulldozer work $56.00, leaves $34.00 per acre for labor, axe and saw depreciation and blasting powder.

Costs of establishing and maintaining pastures, hayfields and grainfields. The costs of managing improved pasture and hay land have been combined because both of these crops are usually managed in the same manner. On the two units with improved pasture, the methods of establishment and treatment after establishment, were the same as for hay. Alsike clover, red clover, and alfalfa are all perennial species, however, to maintain high production they should be occasionally plowed under and reseeded. Martin and Leonard (14) state that red clover agriculturally is a biennial, but that it is well adapted to 3 year rotations. Alsike clover, also a perennial, is adapted to rotations of 4 to 6 years.

The recommended seeding rates for red clover are between 10 and 15 pounds per acre seeded in early spring. That of alsike clover is 8-10 pounds per acre. The recommended alsike clover and timothy mixture requires seeding at the rate of 2 to 4 pounds per acre. A red clover, orchard grass mixture should be seeded at the rate of 14 pounds of seed per acre. At these rates the average cost of seed will amount to $9.72 per acre for red clover, $4.50 per acre for alsike clover, $1.15 per acre for alsike clover-timothy mixture, $8.96 per acre for red clover-orchard grass mixture and $8.40 per acre for alfalfa.

The costs of preparing the seedbed, and seeding the fields are taken from "Rates for Custom Work in Montana" for 1955 by Stucky (28). These rates include charges for machine, tractor and operator or usual crew.

Figure 5. Land being cleared (left center) in the larch-Douglas fir type.

Preparing the seedbed after clearing the land involves plowing and harrowing the land. Some of the operators are using sub-tillage prior to plowing; however, this is not general practice. At least three harrowings are necessary to smooth the seedbed well enough for the seeding of such species as red clover. The charges for this preparation as taken from the above mentioned publication are $3.50 per acre for plowing, $2.25 per acre for harrowing and $1.25 per acre for drilling, or a total of $7.00 per acre for seedbed preparation.

Fertilization practices vary widely from one farm to the next. Some farmers fertilize heavily, others lightly, and still others not at all. For purposes of this study it was decided to compute the fertilizer costs on the basis of the practices used by one operator whose fields produced average yields of improved hay. This operator established his improved pasture and hay with 100 pounds of ammonium sulphate, 100 pounds of 16-20-0 and 100 pounds of gypsum. The cost of $1.25 per acre for spreading this fertilizer added to the cost of the fertilizer brings the total cost of fertilization to approximately $12.00.

Fencing charges are figured at a cost of $500.00 per mile. According to Lancaster, et al. (13), 12 rods of fence per acre are required to enclose an average field of 20 acres. This would involve a fencing charge of approximately $19.00 per acre. This cost should ordinarily occur only once in 20 years.

Summarizing the costs for establishing and maintaining improved and unimproved hayfields, pastures and grain fields table 11shows the annual charges against these types of use. The annual clearing charge is the same for all uses. Under proper management, clearing charges on these

Table 11.—Estimated costs for establishment and maintenance of hay fields, pastures, and grain fields.

	Improved Hayland								
	Red Clover	Alsike Clover	Alfalfa	Improved Pasture	Unimproved Hayland	Unimproved Pasture	Barley	Oats	Wheat
	dollars	dollars	dollars	dollars	dollars	dollars	dollars	dollars	dollars
Annual recovery charge of clearing cost[1]	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70
Seedbed preparation	2.33	1.40	1.40	.21			7.00	7.00	7.00
Seed and seeding	3.24	.90	1.68	.03			3.17	3.93	4.95
Fertilizer	6.00	6.00	6.00	6.00			12.00	12.00	12.00
Annual maintenance of fences	1.95	1.95	1.95	1.95	1.95	1.95	1.95	1.95	1.95
Annual recovery charge of fencing cost[1]	.57	.57	.57	.57	.57	.57	.57	.57	.57
Taxes	.38	.38	.38	.38	.38	.38	.38	.38	.38
Total	17.17	13.90	14.68	11.84	5.60	5.31	27.77	28.53	29.55
Average		15.25		11.84	5.60	5.31	27.77	28.53	29.55

[1] Recovery charge on clearing and fencing are figured on the basis of a cost of $90.00 and $19.00 per acre respectively and are considered permanent investments.

lands should be a relatively permanent investment. Therefore, the cost incurred has been amortized by unlimited capitalization at the rate of 3 percent. The cost of preparing the seedbed and seeding was calculated on the assumption that red clover is to be reseeded every three years and alsike clover and alfalfa is to be reseeded every five years. In these cases the cost of reseeding was simply divided by the number of years each stand should last. Since the only difference in cost between improved timothy-alsike clover pasture and red clover-orchard grass pasture is a slight difference in the cost of seed, these costs have been combined. Fertilizer is figured at the rate of 300 pounds applied every other year. Types of fertilizer vary but prices are generally the same for all except gypsum. Differences in types of fertilizer actually used should not result in too great an error.

Fencing charges are broken down into two specific charges. The initial investment in building a new fence should be a rather permanent investment if the fence is properly maintained. Therefore, the initial cost is recovered over an unlimited period. To this is added an annual maintenance charge figured on the basis of the fence being completely replaced every 20 years.

The rates of seeding used for grain fields are two bushels of barley per acre, four bushels of oats per acre, and two bushels of wheat per acre. Converting these values to dollars and cents, the costs for seed are based on the current price of $.67 per bushel for oats, $.96 per bushel for barley and $1.85 per bushel for wheat. A charge of $1.25 is again added to the seed cost for seeding.

Costs of harvesting hay, pasture and grain. The cost of haying as listed in the "Rates for Custom Work in Montana" (25), is $1.00 for mowing, $.75 for raking, and $4.50 for baling. Adding a charge of $.04 per bale of hay or approximately $.80 per ton for hauling and stacking the charge for haying totals $7.00 per ton.

Custom rates for combining grain are listed at $4.00 per acre. The costs used for hauling farm products to the market are as follows: $.52 per hundred weight for whole milk, $.45 per hundred weight for beef animals and $.16 per bushel for wheat. The cost of hauling milk is based on a charge of $.15 per pound of butterfat being charged by local dairies for hauling milk. This amounts to $.52 per hundred pounds of 5 percent butterfat content milk. The hauling costs of beef are figured on the basis of a stake truck with a 14 foot truck bed hauling fourteen 400 pound animals at a charge of $.25 per mile for 100 miles. This distance was considered an average haul to the market in Missoula from all comparison units.

Prices received for agricultural products. The average prices received by Montana farmers for whole milk in 1954 was $4.19 per hundred weight, for beef cattle $15.35 per hundred weight, and for wheat $2.02 per bushel. These prices were obtained through correspondence with the Montana State College Agricultural Experiment Station. The prices for feeder and stocker cattle of good quality at the present time is between $20.00 and $21.50 per hundred weight at the Missoula, Montana market. Farmers who have pasture to lease and others who have leased pasture state that the average charge is $1.00 per animal unit month. A mature cow with a calf is considered an animal unit.

Hay has sold during the year 1954 at the rate of $10.00 per ton on the stem and $20.00 per ton when cut and stacked. Hay is not often sold on the stem; however, in cases where the owner of the hay has neither the means nor the time to harvest it, he will often attempt to sell it in this condition to a neighboring rancher who has the means of harvesting and the need for additional winter feed.

Income Possibilities from Hay, Pasture and Grain Production.

Possible income from selling forage on the stem. Table 12 shows the net annual income from an acre of land when selling the forage on the stem. The prices used were $10.00 per ton for hay and $1.00 per animal unit month for cow pasture. To facilitate a comparison with the corresponding forest stands the present worth of these annual incomes for the rotation age of the timber stand has been calculated. This was accomplished by substituting the annual net income and interest at the rate of three percent in the formula:

$$\text{Present Worth} = \frac{1.00\ (1.op^{n} - 1)}{.op(1.op)^{n}}$$

For example, the net income from improved hay on comparison units 1 to 4 is equal to $9.00. Using an interest rate of three percent the present worth of this annual net income for the rotation age of the timber stand which in this case is 100 years is:

$$\text{Present Worth} = \frac{9.00(1.03^{100}-1)}{.03(1.03)^{100}} = \$284.31$$

Grain was not compared with the other products at this level.

Table 12.—Net income, capitalized value and discounted future net incomes per acre from hay and pasture sold on the stem.

Comparison Unit	Use	Forage Yield	AUI Days Feed	Sale Price	Product Value	Annual Expenses	Net Annual Yield	Capitalized Value	Present Worth[2]	Present Value
		pounds		dollars	dollars	dollars	dollars	dollars	dollars	dollars
1-4	Imp. Hay	4,851	184	10.00/ton	24.25	15.25	9.00	300.00	222.93	284.31
	Imp. Past.	3,866	193	1.00/AUM	6.40	11.84	-5.44	-181.33	-134.74	-171.84
	Unimp.Past.	2,087	103	1.00/AUM	3.40	5.31	-1.91	-63.66	-47.31	-60.33
5-9	Imp. Hay	4,726	179	10.00/ton	23.63	15.25	8.38	279.33	211.67	264.72
	Unimp.Hay	1,675	45	10.00/ton	8.37	5.31	3.07	102.33	77.54	96.98
	Unimp.Past.	1,642	82	1.00/AUM	2.70	5.31	-2.61	-87.00	-65.92	-82.44
10	Imp. Hay	11,000	425	10.00/ton	55.00	15.25	44.75	1490.00	588.91	1303.00
	Unimp.Past.	1,528	76	1.00/AUM	2.50	5.31	-2.81	-93.66	-369.79	-81.82
11	Imp. Hay	7,209	226	10.00/ton	36.00	15.25	20.79	693.00	234.71	605.40
	Unimp.Past.	906	45	1.00/AUM	1.50	5.31	-3.81	-127.00	-43.01	-110.94
12-13	Unimp. Hay	3,302	121	10.00/ton	16.51	5.31	11.20	373.33	147.39	326.14
	Unimp.Past.	1,650	83	1.00/AUM	2.76	15.31	-2.55	-85.00	-33.55	-74.25

[1] Number of days based on requirement of 13.5 pounds of digestible nutrients per animal unit day which has been increased by 33 percent to allow for frequency of clipping effect and proper use.

[2] This is the discounted annual net income obtained for the period which is necessary to carry the present existing stands to the rotation age.

Possible income from harvested product. Table 13 shows the calculated net returns obtained by harvesting the crop and selling it as a cash crop. This is the value of the product delivered to the buyer. The costs of harvesting are added to the costs of growing the crop. Since hay is usually sold to other farmers and is not delivered by the seller, this cost has not been deducted from gross returns. Pasture forage is not sold at this stage of production and consequently, is not shown in this comparison.

Possible income from converting products to butterfat. Tables 14 and 15 present the values of the various crops using a feed equivalent based on total digestible nutrients produced and required by dairy stock as an index to income. These computations are for the product which leaves the farm in the form of fluid milk. The class of dairy stock used in this analysis are cows producing 22 pounds of five percent butterfat content milk daily. The total digestible nutrients produced and required were taken from Morrison (19). The cost of production other than the cost of feed was calculated on the basis of feed representing 40 percent of the total production costs. From a compilation of data obtained from dairy herd improvement associations in western Montana, Tretsven (29) indicates that the cost of feed for producing milk is 44 percent of the product value for cows producing 400 pounds of butterfat yearly, and 34.5 percent for cows producing 500 pounds of butterfat yearly. A figure of 40 percent was used in this analysis. The feed cost should be lower on farms where the majority of feed is raised on the farm as is the case in the study areas.

Table 13.—Net income, capitalized value and discounted future net incomes per acre from hay and grain delivered.

Comparison Unit	Use	Average Yield[1]	Gross Income[2]	Annual Cost		Net Income	Capitalized Value	Present Worth	Present Value
				Growing	Harvesting				
			dollars	dollars	dollars	dollars	dollars	dollars	dollars
1-4	Imp. Hay	4,851	48.51	15.25	16.80	16.46	548.66	407.71	519.97
	Barley	34	32.64	27.77	4.00	.87	29.00	21.55	27.40
	Wheat	12	22.20	29.55	4.00	-11.35	-378.33	-281.14	-358.54
5-9	Imp. Hay	4,726	47.26	15.25	16.24	15.47	515.66	390.77	488.69
	Unimp.Hay	1,675	16.75	5,31	5.85	5.59	186.33	141.20	176.58
	Barley	44	42.24	27.77	4.00	10.45	348.33	263.96	330.11
	Oats	50	34.17	28.53	4.00	1.54	51.30	38.90	48.65
10	Imp. Hay	11,000	110.00	15.25	38.50	56.25	1,875.00	740.25	1,638.00
	Barley	50	48.00	27.77	4.00	16.22	540.66	213.45	472.32
	Oats	45	30.15	28.53	4.00	-2.38	7.93	31.32	69.30
	Wheat	27	49.95	29.55	4.00	16.40	546.66	216.61	477.56
11	Imp. Hay	7,209	72.09	15.25	25.22	31.62	1,054.00	356.98	920.77
	Barley	44	42.24	27.77	4.00	10.47	349.00	118.20	304.88
12-13	Unimp. Hay	3,302	33.02	5.31	11.55	16.16	538.66	212.66	470.57
	Oats	45	30.15	28.53	4.00	2.38	79.33	313.20	69.30
	Wheat	40	74.00	29.77	4.00	40.45	1,348.33	532.32	1,177.90

[1] Average yield is in pounds of air dry forage for hay and in bushels of grain for barley, oats, and wheat.

[2] Gross income is based on a sale price of $20.00 per ton for hay, $.96 per bushel for barley, $.67 per bushel for oats, and $1.85 per bushel for wheat.

[3] This is the discounted annual net income obtained for the period which is necessary to carry the existing timber stands to the rotation age.

Table 14.—Gross annual returns calculated from total digestible nutrients produced and required as an index to income.

Comparison Unit	Use	Feed Equivalent		Number of Acres Required per Cow per year[2]	Butterfat Produced per acre	Gross Return per acre
		TDN Produced	TDN Required[1]			
		pounds	pounds	acres	pounds	dollars
1-4	Imp. Hay	2,484	6,954	2.65	124.0	136.40
	Imp. Past.	2,613	6,954	2.52	130.0	143.00
	Unimp.Past.	1,391	6,954	7.07	46.6	51.26
	Barley	1,267	6,954	8.20	63.4	69.74
	Wheat	576	6,954	11.44	28.8	31.68
5-9	Imp. Hay	2,429	6,954	2,71	121.8	133.98
	Unimp. Hay	613	6,954	10.75	30.7	33.77
	Unimp.Past.	1,106	6,954	8.89	37.1	40.81
	Barley	1,604	6,954	4.11	80.3	88.33
	Oats	1,121	6,954	5.88	56.1	61.71
10	Imp. Hay	5,742	6,954	1.14	289.5	318.45
	Unimp.Past.	1,033	6,954	6.38	51.7	56.87
	Barley	1,864	6,954	3.53	93.5	102.85
	Oats	1,009	6,954	6.53	50.5	55.55
	Wheat	1,290	6,954	5.11	64.6	71.06
11	Imp. Hay	3,097	6,954	2.15	153.5	168.85
	Unimp.Past	612	6,954	10.77	30.6	33.66
	Barley	1,640	6,954	4.11	80.3	88.33
12-13	Unimp. Hay	1,644	6,954	4.01	82.2	90.42
	Unimp.Past	1,121	6,954	5.88	56.1	61.71
	Oats	1,009	6,954	6.53	50.5	55.55
	Wheat	1,920	6,954	3.43	96.2	105.82

[1] Based on a 1000 pound cow producing 22 pounds of 5 percent b.f.c. milk daily for 300 days.
[2] Total production on unimproved pastures reduced by 33 percent to allow for frequency of clipping and proper use.

Table 15.—Net annual return, capitalized value of the product and present worths of annual net incomes from producing fluid milk with a 1000 pound cow producing 22 pounds of 5 percent b. f. c. milk daily.

Comparison Unit	Use	Cost of Producing Feed	Other Cost	Total Cost	Net Return	Capitalized Value	Present Worth	Present Value
		dollars	dollars	dollars	dollars	dollars	dollars	dollars
1-4	Imp. Hay	32.05	81.84	113.89	22.51	750.33	597.86	711.09
	Imp. Past.	11.84	85.80	97.64	45.36	1,512.00	1,204.76	1,432.29
	Unimp. Past.	5.60	31.35	36.95	14.31	477.00	380.00	452.05
	Barley	31.77	41.84	73.61	-3.87	-129.00	-102.79	-122.25
	Wheat	33.55	19.00	52.55	-20.87	-695.66	-554.31	-659.28
5-9	Imp. Hay	31.79	80.38	112.17	21.81	727.00	550.92	688.97
	Unimp. Hay	11.16	20.26	31.42	2.35	78.33	59.36	74.23
	Unimp. Past.	5.60	24.48	30.08	10.73	357.67	271.03	338.96
	Barley	31.77	52.99	84.76	3.57	119.00	90.17	112.77
	Oats	32.53	37.02	69.55	-7.84	-261.33	-198.03	-247.66
10	Imp. Hay	53.75	191.07	244.82	73.63	2,454.33	968.97	2,144.32
	Unimp. Past.	5.60	34.12	39.72	17.15	571.66	225.69	499.40
	Barley	31.77	61.71	93.48	9.73	324.33	128.04	283.33
	Oats	32.53	33.33	65.86	-10.31	-343.66	-135.68	-300.23
	Wheat	33.55	42.63	76.18	-5.12	-170.66	-67.37	-149.09
11	Imp. Hay	40.47	101.31	141.78	27.07	902.33	305.62	788.27
	Unimp. Past.	5.60	20.19	25.79	7.87	262.33	88.85	229.17
	Barley	31.77	52.99	84.76	3.57	119.00	40.30	103.95
12-13	Unimp. Hay	16.86	54.25	71.11	19.31	643.66	254.11	562.37
	Unimp. Past.	5.60	37.02	42.62	19.09	636.33	251.33	555.96
	Oats	32.53	33.33	65.86	-10.31	-343.66	-135.67	-300.22
	Wheat	33.55	63.49	97.04	8.78	292.67	115.54	255.67

Table 16.—Gross annual returns calculated from total digestible nutrients produced and required as an index to income.

Comparison Unit	Use	Feed Equivalent		Number of Acres Required per Cow per year[2]	Beef Produced per acre[1]	Gross Return per acre
		TDN Produced	TDN Required			
		pounds	pounds	acres	pounds	dollars
1-4	Imp. Hay	2,484	5,334	2.14	140	28.00
	Imp. Past	2,613	5,334	2.04	147	29.40
	Unimp. Past	1,391	5,334	3.83	78	15.60
	Barley	1,267	5,334	4.20	71	14.20
	Wheat	576	5,334	19.26	16	3.20
5-9	Imp. Hay	2,429	5,334	2,19	137	27.40
	Unimp. Hay	613	5,334	8.70	34	6.80
	Unimp. Past.	1,106	5,334	4.82	62	12.40
	Barley	1,604	5,334	3.25	92	18.40
	Oats	1,121	5,334	4.76	63	12.60
10	Imp. Hay	5,742	5,334	.93	322	64.40
	Unimp. Past.	1,033	5,334	5.16	58	11.60
	Barley	1,864	5,334	2.86	104	20.80
	Oats	1,009	5,334	5.28	57	11.40
	Wheat	1,290	5,334	4.13	73	14.60
11	Imp. Hay	3,057	5,334	1.74	172	34.40
	Unimp. Past.	612	5,334	8.71	34	6.80
	Barley	1,640	5,334	3.25	92	18.40
12-13	Unimp. Hay	1,644	5,334	3.24	92	18.40
	Unimp. Past.	1,121	5,334	4.75	63	12.60
	Oats	1,009	5,334	5.28	57	11.40
	Wheat	1,920	5,334	2.77	108	21.60

[1] Based on a 1000 pound cow producing 300 pounds of beef per year.
[2] Total production on unimproved pastures reduced by 33 percent to allow for frequency of clipping and proper use.

Table 17.—Net annual return, capitalized value of the product and present worths of annual net incomes from producing beef with a 1000 pound cow producing an average of 300 pounds of beef annually.

Comparison Unit	Use	Cost of Producing Feed	Other Cost	Total Cost	Net Return	Capitalized Value	Present Worth	Present Value
		dollars	dollars	dollars	dollars	dollars	dollars	dollars
1-4	Imp. Hay	32.05	8.40	40.45	-12.45	-415.00	-330.67	-393.42
	Imp. Past.	11.84	8.82	20.66	8.74	291.33	232.13	276.18
	Unimp. Past.	5.60	4.68	10.68	5.32	177.33	141.30	168.11
	Barley	31.77	4.26	36.03	-21.83	-727.66	-580.07	-689.82
	Wheat	33.55	.96	34.51	-31.31	-1043.66	-831.59	-989.39
5-9	Imp. Hay	31.79	8.22	40.01	-12.61	-420.33	-318.53	-398.47
	Unimp. Hay	11.16	2.04	13.20	-6.40	-213.33	-161.66	-202.24
	Unimp. Past.	5.60	3.72	9.32	3.08	102.66	77.80	97.32
	Barley	31.77	5.52	37.29	-18.89	-629.66	-477.16	-596.92
	Oats	32.53	3.78	36.31	-23.71	-790.33	-598.91	-749.24
10	Imp. Hay	53.75	19.32	73.07	-8.67	-289.00	-114.09	-252.47
	Unimp. Past.	5.60	3.48	9.08	2.52	84.00	33.16	73.38
	Barley	31.77	6.24	38.01	-17.21	-573.66	-226.48	-501.16
	Oats	32.53	3.42	35.95	-24.55	-818.33	-323.08	-714.89
	Wheat	33.58	4.38	37.96	-23.36	-778.66	-308.73	-680.24
11	Imp. Hay	40.47	10.32	50.79	-16.39	-546.33	-185.20	-477.27
	Unimp. Past.	5.60	2.04	7.64	.84	28.00	9.49	24.46
	Barley	31.77	5.52	37.29	-18.89	-629.66	-213.45	-550.08
12-13	Unimp. Hay	16.86	5.52	22.38	-3.98	-132.56	-52.37	-115.89
	Unimp. Past.	5.60	3.78	9.38	3.22	107.33	42.37	93.77
	Oats	32.53	3.42	35.95	-24.55	-818.33	-323.08	-714.89
	Wheat	33.55	6.48	40.03	-18.43	-614.66	-242.67	-536.97

Possible income from converting products to beef. Table 17 shows these values for beef production. This analysis is based on a cow producing 300 pounds of beef per year. Spring calves marketed in the autumn should average 400 pounds. Allowing 25 percent of the increase for herd replacement, death loss, and loss in calving, the net production would be 75 percent of 400 pounds or 300 pounds.

The pounds of digestible nutrients required for a cow producing a calf comes to 5334 pounds (19). This total is for a 1000 pound cow, nursing a calf for 120 days, putting on fat for 60 days after weaning, and wintering for 150 days. To this has been added an allowance for rapid growth of calves from weaning time until marketing time. At a price of $.20 per pound of beef produced as the farmers share, the value per 100 pounds of digestible nutrients is $1.49. Table 17 shows the net return per acre figuring the cost of production other than feed at 30 percent of the total cost (30). The present worth of this annual net income is again calculated by the formula described previously.

ECONOMIC COMPARISON OF TIMBER VALUES WITH HAY, PASTURE AND GRAIN VALUES

Comparison of Net Incomes from Production over the Period Necessary to Carry Timber Stands to Rotation Age

Table 18 shows a comparison of the estimated net income discounted from the rotation age of the existing stands to the present time. This table shows the present worths of the net income where the products are sold standing in the field, forest stumpage on one hand, standing forage on the other and the present worth of the net incomes when the products are harvested and sold as sawlogs, hay, and grain.

In table 19 is a comparison of the income from the sale of sawlogs relative to the sale of forage and grain which has been converted to a feed equivalent based on total digestible nutrients. This comparison is also for the existing stands discounted from the rotation age to the present time.

Comparison of Net Income from Production Over One Complete Rotation

Tables 20 and 21 show the comparative present values of the expected crops over the rotation ages of the timber stands. These are the values of the soil for producing a net income from each of the various products. The capitalized values of the soil for producing forest, grain and forage have been computed for the calculated rotation ages of the corresponding timber stands and discounted to the beginning of the rotation, as shown for timber in tables 9 and 10 and for hay, pasture and grain in tables 12, 13, 15 and 17.

Table 18. Present worth of the future net returns for the period required to carry the existing forest stands to the end of the first rotation.

	Comparison Units 1-4	Comparison Units 5-9	Comparison Units 10	Comparison Unit 11	Comparison Units 12-13
	Values for products sold on the stem[1]				
	dollars	dollars	dollars	dollars	dollars
Forest	37.94	26.22	83.62	46.01	-2.42
Hay					
Improved	222.93	211.67	528.91	234.71	
Unimproved		77.54			147.39
Pasture					
Improved	-134.34				
Unimproved	-47.31	-65.92	-369.79	-43.01	-33.55
	Values for products harvested and delivered[2]				
	dollars	dollars	dollars	dollars	dollars
Forest	33.03	20.21	131.84	127.47	63.84
Hay					
Improved	407.71	390.77	740.25	356.98	
Unimproved		141.20	213.45		212.66
Grain					
Barley	21.55	263.96		118.20	313.20
Oats		38.90	31.32		
Wheat	-281.14		216.61		532.32

1 Sold as forest stumpage or as hay and pasture standing on the stem in fields.

2 Delivered to usual buyer. Sawlogs are usually delivered to local mills, hay usually sold in the stack and grain delivered to railroad loading points.

Table 19. Present worth of the future net returns for the period required to carry the forest stands to the end of the first rotation.

	Comparison Units 1-4	Comparison Units 5-9	Comparison Unit 10	Comparison Unit 11	Comparison Units 12-13
Values for forage and grain when converted to fluid milk and delivered to dairy,[1] and values for sawlogs delivered to the mill.					
	dollars	dollars	dollars	dollars	dollars
Forest	33.03	20.21	131.84	127.47	63.84
Hay					
Improved	597.86	550.92	968.97	305.62	
Unimproved		59.36			254.11
Pasture					
Improved	1204.76				
Unimproved	380.00	271.03	225.69	88.85	251.33
Grain					
Barley	-102.79	90.17	128.04	40.30	
Oats		198.03	-135.68		-135.67
Wheat	554.31		-67.37		115.54
Values for forage and grain when converted to beef and delivered to buyer.[2] Sawlogs delivered to mill.					
	dollars	dollars	dollars	dollars	dollars
Forest	33.03	20.21	131.84	127.47	63.84
Hay					
Improved	-330.67	-318.53	-114.09	-185.20	-52.37
Unimproved		- 161.66	33.16		
Pasture					
Improved	232.13				
Unimproved	141.30	77.80		9.49	42.37
Grain					
Barley	-580.07	-477.16	-226.48	-213.45	
Oats		-598.91	-323.08		-323.08
Wheat	-851.59		-308.73		-242.67

[1] A charge of $.15 per pound of butterfat is made by the creamery to haul milk from roadside to creamery.

Table 20. Present value of Fe for the various products by forest type and site class.

	Comparison Units 1-4	Comparison Units 5-9	Comparison Unit 10	Comparison Unit 11	Comparison Units 12-13
	Values for products sold on the stem[1]				
	dollars	dollars	dollars	dollars	dollars
Forest	4.31	2.77	14.20	7.33	2.19
Hay					
Improved	284.31	264.72	1303.00	605.40	
Unimproved		96.98			326.14
Pasture					
Improved	-171.84				
	-60.33	-82.44	-81.82	-110.94	-74.25
	Values for products harvested and delivered[2]				
	dollars	dollars	dollars	dollars	dollars
Forest	3.40	2.16	23.59	11.92	3.87
Hay					
Improved	519.97	488.69	1638.00	920.77	
Unimproved		176.58			470.57
Grain					
Barley	27.40	330.11	472.32	304.88	
Oats		48.65	69.30		69.30
Wheat	-358.54		477.56		1177.90

[1] Sold as forest stumpage or as hay or pasture on the stem.
[2] Delivered to usual buyer. Sawlogs are usually delivered to local mills, hay is usually sold in the stack and grain is delivered to railroad loading points.

Table 21. Present value of Fe for the various products by forest type and site class.

	Comparison Units 1-4	Comparison Units 5-9	Comparison Unit 10	Comparison Unit 11	Comparison Units 12-13
Values for forage and grain when converted to fluid milk and delivered to dairy,[1] and values for sawlogs delivered to the mill.					
	dollars	dollars	dollars	dollars	dollars
Forest	3.40	2.16	23.59	11.92	3.87
Hay					
Improved	711.09	688.97	2144.32	788.27	
Unimproved		74.23			562.37
Pasture					
Improved	1432.29				
Unimproved	452.05	338.96	499.40	229.17	555.96
Grain					
Barley	-122.25	112.77	283.33	103.95	
Oats		-247.66	-300.23		-300.22
Wheat	-659.28		-149.09		255.67
Values for forage and grain when converted to beef and delivered to buyer.[2] Sawlogs delivered to mill.					
	dollars	dollars	dollars	dollars	dollars
Forest	3.40	2.16	23.59	11.92	3.87
Hay					
Improved	-393.42	-398.47	-252.47	-477.27	
Unimproved		202.24	73.38		-115.87
Pasture					
Improved	276.18				
Unimproved	168.11	97.32		24.46	93.77
Grain					
Barley	-689.82	-596.92	-501.15	-550.08	
Oats		-749.24	-714.89		-714.89
Wheat	- 989.39		-680.24		-536.97

[1] A charge of $.15 per pound of butterfat is made by the creamery to haul milk from roadside to creamery.

Comparison of Product Values to the Community

In an attempt to obtain a better measure of the values the products contribute to the community and western Montana, tables 22 through 24 show the gross value of an acre's production at three price levels.

Agricultural and forest products being difficult to standardize and subject to widely fluctuating markets, make it difficult to arrive at a fair market price. Current prices, which are considered to be approximately average by several interested firms and agencies in western Montana, are usedto compare the values of different products at different market levels. In table 22 are the prices received by the farmer for the product delivered in the stage of processing in which it usually leaves the farm. For sawlogs this is the estimated current price for the average annual growth per acre of logs delivered to the mill. Prices for hay, pasture and feed grains are the delivered prices for butterfat and beef to which the forage production per acre has been converted. The prices used are $1.25 per pound for butterfat (in fluid milk), $.20 per pound for beef, $27.00 per thousand board feet for larch and Douglas fir sawlogs and $42.50 for ponderosa pine sawlogs.

Wholesale and retail prices are current prices being received in Missoula at these levels. Table 23 shows these values as they leave the initial processing plants. These are values for processed milk valued at $.16 per quart or $2.28 per pound for butterfat in milk (fluid milk sold contains at least 3.5 percent butterfat content), $.45 per pound for beef, $86.00 per thousand board feet for larch and Douglas fir lumber and $129.00 per thousand board feet for ponderosa pine lumber.

Table 22. Sale value of one acre's production delivered to the initial processing plant.

Use	Product	Comparison Units: Unit 1 -4	Unit 5 -9	Unit 10	Unit 11	Unit 12-13
		dollars	dollars	dollars	dollars	dollars
Forest	Sawlogs	7.10	4.69	10.07	5.44	1.99
Hay						
Improved	Butterfat	155.00	152.25	361.87	191.87	
	Beef	28.00	27.40	64.40	34.40	
Unimproved	Butterfat		38.37			102.75
	Beef		6.80			18.40
Pasture						
Improved	Butterfat	162.50				
	Beef	29.40				
Unimproved	Butterfat	58.25	46.37	64.62	38.25	70.12
	Beef	15.60	12.40	11.60	6.80	12.60
Barley	Butterfat	79.25	100.05	116.87	100.05	
	Beef	14.20	18.40	20.80	13.40	
Oats	Butterfat		70.01	63.12		63.12
	Beef		12.60	11.40		11.40
Wheat	Butterfat	36.00		80.75		120.25
	Beef	3.20		14.80		21.60

Table 23. Sale value of one acre's production at the wholesale level

Use	Product	Unit 1 -4	Unit 5 -9	Unit 10	Unit 11	Unit 12-13
Forest	Lumber	22.62	14.96	30.57	16.51	6.06
Hay						
Improved	Butterfat	282.72	277.70	660.06	349.98	
	Beef[1]	37.80	36.99	186.94	46.44	
Unimproved	Butterfat		69.99			187.41
	Beef[1]		9.18			24.84
Pasture						
Improved	Butterfat	296.40				
	Beef[1]	39.69				
Unimproved	Butterfat	106.24	84.58	117.87	69.76	127.90
	Beef[1]	21.06	16.74	15.66	9.18	17.01
Barley	Butterfat	144.55	183.08	213.18	183.08	
	Beef[1]	19.17	24.84	28.08	24.84	
Oats	Butterfat		127.90	115.14		115.14
	Beef[1]		17.01	15.39		15.39
Wheat	Butterfat	37.80		33.75		34.20
	Beef[1]	4.32		19.71		29.16

[1] Figured on the basis of 60 percent of live weight.

Table 24. Sale value of one acre's production at the retail level

Use	Product	Comparison Units				
		Unit 1-4	Unit 5-9	Unit 10	Unit 11	Unit 12-13
Forest	Lumber	31.56	20.38	43.27	23.37	8.58
Hay						
Improved	Butterfat	372.00	365.40	868.50	460.50	
	Beef[1]	57.12	55.89	131.37	70.17	
Unimproved	Butterfat		92.10			246.60
	Beef[1]		13.87			37.53
Pasture						
Improved	Butterfat	390.00				
	Beef[1]	59.97				
Unimproved	Butterfat	139.80	111.30	155.10	91.80	168.30
	Beef[1]	31.82	25.29	23.66	13.87	25.70
Barley	Butterfat	190.20	240.90			
	Beef[1]	28.96	37.53			
Oats	Butterfat		168.30	151.50		151.50
	Beef[1]		25.70	23.25		23.25
Wheat	Butterfat	86.40		193.80		288.60
	Beef[1]	6.52		29.78		44.06

[1] Figured on the basis of 60 percent of the live weight to allow for the dressing loss.

Since retail prices for lumber vary considerably from the lowest to the highest grade, the price for number two common, which is $120.00 per thousand board feet for larch and Douglas fir lumber and $182.60 for ponderosa pine lumber are used. These are the prices being charged at local retail outlets. The retail price for butterfat in fluid milk, sold at the price of $.21 per quart is $3.00 per pound of butterfat. The retail price for beef used is $.68. This is the national average for choice grade beef as reported by the Agricultural Marketing Service of the United States Department of Agriculture. (31).

DISCUSSION OF THE RESULTS

The results of this study indicate that improved dairy pasture followed by improved hay and unimproved pasture for dairy purposes, in that order, provide the largest net returns to the landowner on the cut-over lands. When total digestible nutrients are used as an index to the production of whole milk, improved pasture provides more than twice the net income to the landowner than does the improved hay and over three times the net income from improved pastures. When the cost of producing digestible nutrients in the form of hay for beef animals is considered, negative values result. Whether the income from pasture for beef production is large enough to compare with the return from producing sawlogs will depend upon the amount of pasture used relative to the amount needed for hay. The cost of producing feed grains are greater than the returns obtained from them when considering their value for the sum total of digestible nutrients alone. A certain amount of each of these feeds are desirable in making up the daily ration of producing animals. The net cost of producing one component of the ration will have to be paid from the return or another cheaper source of digestible nutrients.

Using the estimated costs of harvesting timber crops and the price of sawlogs delivered, a smaller net return is obtained by selling larch-Douglas fir sawlogs than from selling stumpage. There is an opportunity for additional income from the labor in harvesting the timber crop even

though the net return for profit and risk is less. Harvesting ponderosa pine provides an income from labor plus a larger net return over that of selling it as stumpage according to this analysis. The annual cost of owning and maintaining pastures is greater than the gross return of $1.00 per animal unit month rental. The carrying capacity of the pastures is not great enough to offset the costs of clearing, fencing and taxes when figured at this rate. The additional cost of improving and maintaining the pasture increases the net cost. The additional carrying capacity resulting from reseeding and fertilizing does not compensate for the additional cost when the rent is figured at $1.00 per animal unit month. In this case these results indicate that it would be more profitable to leave the timber land for the production of lumber.

There are values from owning forest land which have not been included in this analysis but which are, under present market conditions, considered relatively unimportant. If fence posts and poles can be sold at a profit, some intermediate cuttings can contribute to the returns obtained from the forest. At present the post and pole market is not active enough to contribute a dependable source of additional income. The producers state that the reason they are not thinning their larch stands and marketing poles is that the markets are too far away for them to realize a return large enough to pay the costs of handling. There is a post and corral pole yard in the town of Trout Creek in western Sanders County. An interview with the operator of this plant indicates that the market for these products is not very dependable.

Facilities for treating the more valuable, longer poles are located no closer than Libby, Montana or St. Maries, Idaho.

Taking advantage of the accumulated growth on the existing timber stands and holding them until the end of the first rotation increases the relative net return per acre considerably. Table 19 shows that the productivity of all pastures except one, that on comparison unit 11, is great enough to warrant the clearing of the land for dairy purposes. According to these results it would be more profitable to hold the existing ponderosa pine stands in timber than to clear them and convert the land into beef pasture. Over the complete rotation all uses except grain, pasture rented out, and hay produced for beef purposes provide a greater return per acre than timber. Much depends upon the organization of the unit and the efficiency of the operator as to whether the landowner can realize a greater over-all profit from raising agricultural crops than he can obtain from holding his land in timber.

The capitalized values obtained for the land in this study are not very realistic. In some cases they are much greater than the actual price of the land and in others they are much lower. The capitalized returns are considered of value mainly as a relative figure and not as an absolute figure. The results of any analysis such as this will vary according to the yields obtained which are in turn influenced by differences in weather conditions. Production records from cut-over lands over a large number of years would be highly desirable. Such records would give a sounder basis for calculating net returns and would permit the introduction of a factor for risk.

For comparing the product values to the community, tables 22 through 24 show the relative prices of these products at three levels, any one of

which may represent the value of the product to the community. For example, in the larch-Douglas fir type much of the fluid milk leaves the farm and is shipped directly to Spokane, Washington for initial processing. Much of the beef is shipped out of the community unprocessed. Sawlogs from this area for the most part are processed into finished lumber before they leave the locality. An equitable comparison would then be the value of the whole milk as it leaves the farm with the value of the lumber as it leaves the sawmill. Under these conditions the product value of forest at the wholesale level contributes more in revenue to the community than the product value of unimproved pasture and unimproved hay land used for beef production, but does not equal the product value of improved hay land and improved pasture. According to this analysis pasture used as dairy pasture contributes the most of the products being compared in gross income to the community.

SUMMARY AND CONCLUSIONS

A study was conducted for the purpose of attempting a comparison of land use values on the cut-over lands in western Montana. Production figures of the cut-over lands in this section of the state in forest, hay, pasture and grain production were determined for the growing season of 1954.

The comparative value of the soil for producing the various crops was calculated at the following levels: (1) Values on the stem, (2) values of the harvested product delivered to the initial processing plant in the form of hay, grain, butterfat and beef, (3) value of the product to the community. Comparisons on the stem were made on the basis of timber stumpage versus hay and pasture sold as standing forage in the field. The comparison of harvested product included a comparison of forest production with butterfat and beef. Conversion of forage and grain to butterfat and beef was facilitated by use of a feed equivalent based on total digestible nutrients produced on the land and required by dairy and beef animals.

On the basis of this analysis, improved hay, sold on the stem contributes more in net income to the landowner than forest stumpage or pasture rental. Improved pastures when leased at $1.00 per month show negative values. In this respect either the lease rate is not high enough to pay the annual land charges or the consumption of feed by the class

of animal used as an animal unit is too high. There is little attention paid to the size of animal considered an animal unit by the rancher. He is interested more in the numbers and ages of the animals than in the particular weight and feed requirements.

When the products of the soil are harvested, delivered and sold this analysis shows that improved pasture and improved hay land grazed by relatively high producing dairy cows yield the greatest net income to the landowner. These figures indicate that the sale of the hay in the form of beef provides a smaller return than the sale of sawlogs delivered to the mill pond. Negative values were obtained for all cases where beef was produced on feed which had to be harvested prior to feeding. Where beef animals consume forage as pasture the net returns were found to be generally higher than the net returns from the production of timber stumpage or sawlogs.

A comparison of product values to the community indicate that timber when processed into finished lumber in the community contribute a larger gross return to the community than unimproved pasture which is shipped outside the community in the form of beef on the hoof; however, where beef is slaughtered within the community it contributes more to community wealth than timber.

The use of the land for the production of fluid milk provides the greatest income at all levels of the products being compared.

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APPENDIX

Example of analyses for existing timber stands. This includes the stands found on comparison units 1 through 4. These are larch-Douglas fir stands in site class I, 60 percent stocked at an age of 46 years and containing 899 board feet of merchantable timber at present.

Value of stumpage at 100 years @ $10.00 per M	$263.17
Value of stumpage at present @ $10.00 per M	$ 8.99
Gross increase in stumpage value over 54 years	$254.18

Annual expenses:

Protection @ $.05 per acre, per year for 54 years

Taxes @ $.09 per acre per year for 54 years

Value of the above expenses 54 years hence is as follows:

$$Vn = \frac{r(1.op^n-1)}{.op} = \frac{.14(1.03^{54}-1)}{.03} = \frac{.5488}{.03} = \$\ 18.29$$

Net gain in stumpage value 54 years hence	$235.89
Average annual gain in value	$ 5.13

Interest on the investment of $10.00 in land @ 3 percent.

$$Vn = Vo\ (1.op^n) = \$10.00(1.03^{54}) = 10(4.92) = \$\ 49.20$$

Present worth of this future net income.

$$Vo = \frac{Vn}{1.op^n} = \frac{\$186.69}{1.03^{54}} = \frac{\$186.69}{4.92} = \$\ 37.94$$

If the product is to be harvested and sold as sawlogs delivered to the mill the following calculations show the estimated returns:

Value of sawlogs at 100 years (26,317 bd. ft. @$27.00 per M)		$710.56
Annual Expenses	$18.29	

Logging costs,

Felling, limbing and bucking $2.75 per M	
Skidding $7.00 per M	
Loading $1.00 per M	
Slash disposal $.75 per M	
Hauling ($.25 per M bd. ft. for 30 miles) $7.50 per M	
Total ($19.00 per M bd. ft. for 26,317 bd. ft. $479.87	$497.87

Interest on the investment of $10.00 in land.

$Vn = Vo\ (1.op^{n}) = 10\ (1.03^{54}) = 10(4.92) = \$49.20$

Future net return from logs delivered to the mill $162.55

Present worth of this future net income.

$$Vo = \frac{Vn}{1.op^{n}} = \frac{162.55}{1.0354} = \frac{162.55}{4.92} = \$\ 33.03$$

Table 1. The effect of the length of the rotation on the present value of the soil for producing larch-Douglas fir stumpage on site class I.

Rotation	Yield	Yield @$10.00 per M	Annual Expenses	Net Yield	Mean Annual Yield	Capitalized Value	Present Value
years	bd.ft.	dollars	dollars	dollars	dollars	dollars	dollars
70	8,772	87.72	9.80	77.92	1.11	37.00	4.67
80	13,855	138.55	11.20	127.35	1.59	53.00	4.98
90	20,509	205.09	12.60	192.49	2.13	71.00	4.96
100	26,317	263.17	14.00	249.17	2.49	83.00	4.31
110	31,097	310.97	15.40	295.57	2.68	89.30	3.47

Table 2. The effect of the length of rotation on the present value of the soil for producing larch-Douglas fir stumpage on site class II.

Rotation	Yield	Yield @$10.00 per M	Annual Expenses	Net Yield	Mean Annual Yield	Capitalized Value	Present Value
years	bd.ft.	dollars	dollars	dollars	dollars	dollars	dollars
80	8,320	83.20	11.20	72.00	.90	30.00	2.81
90	12,276	122.76	12.60	110.16	1.22	40.66	2.84
100	17,423	174.23	14.00	160.23	1.60	53.33	2.77
110	22,574	225.74	15.40	210.34	1.91	63.66	2.47

Table 3. The effect of the length of the rotation on the present value of the soil for producing ponderosa pine stumpage on site class II.

Rotation	Yield	Yield @$10.00 per M	Annual Expenses	Net Yield	Mean Annual Yield	Capitalized Value	Present Value
years	bd.ft.	dollars	dollars	dollars	dollars	dollars	dollars
50	7,452	111.77	7.00	104.77	2.09	69.66	13.62
60	11,980	179.82	10.80	169.02	2.81	93.66	15.90
70	16,605	249.07	12.60	236.47	3.37	112.33	14.20
80	21,060	315.90	14.40	301.50	3.76	125.33	11.77
90	25,252	379.08	16.20	362.88	4.03	134.00	9.37
100	29,241	438.61	18.00	420.61	4.20	140.00	7.28

Table 4. The effect of the length of the rotation on the present value of the soil for producing ponderosa pine stumpage on site class III.

Rotation	Yield	Yield	Annual Expenses	Net Yield	Mean Annual Yield	Capitalized Value	Present Value
years	bd.ft.	dollars	dollars	dollars	dollars	dollars	dollars
60	3,315	38.73	10.80	77.93	1.95	43.00	7.30
70	8,970	134.55	12.60	121.95	1.74	58.00	7.33
80	12,025	180.37	14.40	165.97	2.07	69.00	6.48
90	14,950	224.25	16.20	208.05	2.31	77.00	5.38
100	17,680	265.24	18.00	247.24	2.47	82.33	4.28

Table 5. The effect of length of rotation on the present value of the soil for producing ponderosa pine stumpage on site class IV.

Rotation	Yield	Yield	Annual Expenses	Net Yield	Mean Annual Yield	Capitalized Value	Present Value
years	bd.ft.	dollars	dollars	dollars	dollars	dollars	dollars
70	3,289	49.33	12.60	36.73	.52	17.33	2.19
80	5,355	80.32	14.40	65.92	.82	27.33	2.56
90	7,650	114.75	16.20	98.55	1.09	36.33	2.54
100	10,021	150.31	18.00	132.31	1.32	44.00	2.29